The Water Crisis In And Around The Kruger National Park, South Africa: Which Way?

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ABSTRACT

Rivers in the Kruger National Park are very important in the management of biodiversity. These rivers originate from outside the Kruger National Park and the impacts on these rivers upstream and adjacent to the Kruger National Park have resulted into high silt levels in the rivers. Different forms of pollution are also on the increase and the decrease in the quantity of the water in the rivers (flow) which affects the pollution level, has been a major source of concern. The aquatic biodiversity in the Kruger National Park including some fish species has however been found to be decreasing as a result of the different impacts. Different forms of water use, legal and illegal, various forms of pollution have compounded the problem. It is recommended that the environmental water requirements for all the rivers passing through Kruger National Park be determined as soon as possible and relevant legislation enforced when and where necessary, to ensure the proper and sustainable utilisation of water resources in the region.

Key words: *Biodiversity, pollution, abstraction, sustainable, reserve*

1. INTRODUCTION

The world's limited reserves of clean, fresh water are shrinking fast, posing a serious threat to public health, political stability and the environment (*Weiss* 2003). Water is increasingly seen as a limited commodity around the world. Water is a vital resource for South Africa's future prosperity. Its sustainable use within an integrated natural resources management framework for economic, social and environmental gains underpins activity in the government, industry and community sectors. We therefore need to guard against the mismanagement of our water resources in the best interest of all who use the water.

The Kruger National Park was established in 1889 to protect the wildlife of the South African Lowveld. The Park covers an area of approximately 2 million hectares, and it is unrivalled in the diversity of its life forms and a world leader in advanced environmental management techniques and policies. Truly the flagship of South African national parks, Kruger Park is home to an impressive number of species, including; 49 fish, 34 amphibians, 114 reptiles, 507 birds and 147 mammals. Apart from the fish and amphibians that directly depend on the water resource, the other forms of life depend on the available water resources in the park in different ways.

According to the Environmental Affairs and Tourism Minister, Mr. Marthinus van Schalkwyk), a shocking 82% of South Africa's 120 rivers are ecologically threatened, with 44% being critically endangered. Although, the environment is recognized as a legitimate user of water, not many stakeholders accept this fact. This covers both surface and groundwater dependent ecosystems, streams, lakes, wetlands and springs. Providing water for the environment is necessary to ensure ecosystem integrity, productivity and long term sustainability. Healthy water dependent ecosystems contribute to the health of the water resources that sustain our industries and the community's economic, social and environmental values.

The climate in the KNP is subtropical with hot summers and warm, dry winters. Summer rains fall between October and March. The rainfall season is very erratic and most at times have dry spells throughout the year with occasional one to two rainfalls in a year depending on the location.

The way in which a river functions depends on the nature of the terrain through which it flows, the relief, climate, and human activity in the catchment. For this reason, there is wide environmental diversity in aquatic systems, and in particular, the KNP systems. The contrast in climate, scenery and landscape are both striking and dramatic, and so are the many land use and water use activities in the catchments involving the KNP.

Beneficial action in one place will not necessarily work elsewhere. In the same vein, pollution discharged into a river in the Vaal Catchment will not have the same impact as in the Olifants River. The rivers draining through the KNP are used for different purposes, including agriculture, mining, industrial, dams for purification purposes to serve human needs and finally for biodiversity conservation. Above all these varied uses is the need to allow some amount of water to drain into our neighbouring country, Mozambique.

These activities notwithstanding, some transfers out of the systems involving the Kruger National Park have officially been sanctioned and additional stress is imposed on the river systems. The Crocodile River in the southern part of the KNP is an example of a losing river basin. It is therefore a losing river basin.

The catchments of the KNP are illustrated in Figure 1, below.

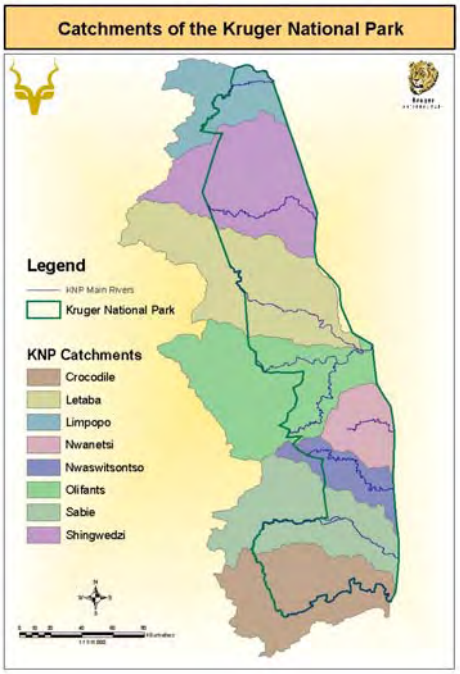

Figure 1: Catchments of the Kruger National Park

As can be seen in Figure 1, all the main catchments involving the KNP originate from outside the KNP. As a result, the developmental pressures upstream impact negatively on the downstream users, comprising the KNP and Mozambique.

2. THE PROBLEM

The rivers draining through the KNP are greatly over-utilised. Pollution from various sources compounds the problem thereby degrading the riverine habitats and reducing the supply and quality of the river water. The Kruger National Park has a mission to "…protect biodiversity in all its facets and fluxes…", which originates from the South African National Parks mission; "To develop and manage a system of national parks that represents the biodiversity, landscapes, and associated heritage assets of South Africa for the sustainable use and benefit of all".

The quantity and quality of the rivers are continuously deteriorating to the detriment of the biodiversity and this is making it difficult for the Kruger National Park to achieve its mission/vision. Siltation and sedimentation in the river generated upstream. There are various threats to the ecosystem in all the rivers involving the KNP when it comes to water availability.

An ongoing study in the Luvuvhu system (Griscom, Scott-Miller and Gyedu-Ababio) using software that measures the degree of hydrologic alteration from discharge records, it does appear that the Luvuvhu River and its tributaries are drier in the dry season, and wetter in the wet season than they were historically. It is believed that this is primarily the result of dam management and dam and river abstractions. Irrigated agriculture (primarily in the Levubu settlement area near Albasini Dam) is using 70% of all the water removed from the Luvuvhu Catchment. So, it seems likely that this direct removal in the dry season is the main cause of river drying. Many examples occur in other catchments involving, Agriculture, Industry, etc., which do not seem to be properly monitored by the authorities concerned.

The flow of the various rivers in the KNP over a five-year-period is presented below (Figure 2).

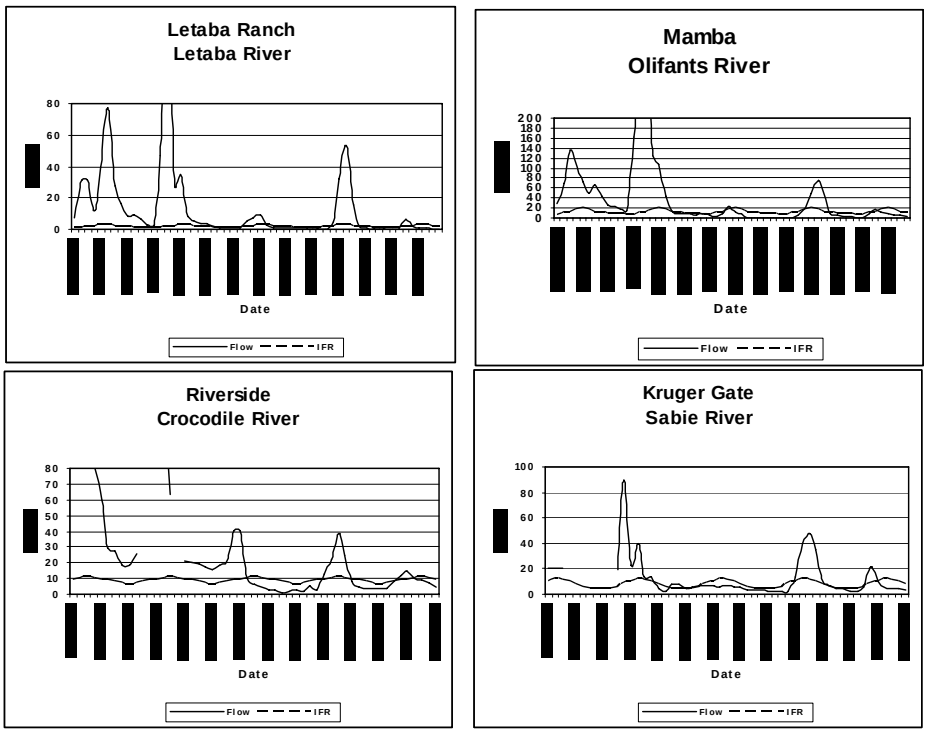

Figure 2: Five-year average of flows in the major rivers in the KNP

Figure 2 indicates that the instream flow requirements of the Kruger National Park Rivers are not met for greater part of each year. The current drought situation is making the situation worse. Presently, none of the rivers is achieving the stipulated IFR.

2.1 Water Quality

Water Quality has also deteriorated over time. A contributing factor to the deteriorating water quality is the over abstraction. The little amount of water that remains in the system become saturated with dissolved substances to such an extent that it becomes unsuitable for some of the sensitive species in the water. As indicated earlier, the catchments have a host of land/water uses. These include mining, industrial, domestic and agricultural activities. Sewage effluent problems have created microbiological pollution in the river systems. An example is found in the Crocodile River System where the pollution emanating from the municipal and private waste water treatment works is a constant feature. Mining activities also contribute to quality problems in the rivers. The Olifants River is a good example of a system that has been impacted by mining and industrial activities. Agricultural activities along the stretch of the rivers have contributed to the nutrient loads in the rivers. The growth of algae in the rivers has resulted from the nutrient build ups. The growth of aquatic alien weeds like Hyacinths is also encouraged by the increase in nutrient loads. According to the old KNP water policy document, the “abuse” of perennial rivers in the KNP in the form pollution and abstractions started as far back as 1920 with the advent of industrial and agricultural development in the lowveld and adjoining areas.

2.2 Dams and Weirs

The building of dams and numerous weirs for the balancing of water in the river systems has not helped the problem either. Big Dams like the Nandoni Dam on the Luvuvhu River have no fish ways. This prevents the migration of aquatic biodiversity from one end to the other – in some cases for spawning purposes. These structures on the rivers have contributed immensely to the accumulation of silt/sediment in the system. Flush floods push considerable amounts of the silt downstream affecting the aquatic biodiversity in different ways, including the destruction of habitats and impeding food acquisition. The building of the Phalaborwa barrage added another serious impact on the biodiversity in the Kruger National Park stretch of the Olifants River (see impacts).

Other trends that have been observed are flashier floods and changes in the timing of dry and wet pulses. Flashier floods could be the result of land cover change or dam management, and the timing question is probably dam-related. Of course, all of these changes are possible future problems for riparian trees, and fish and invertebrate reproduction within KNP. The silting of the rivers had also increased from the mid-1940. The silting of the rivers and the subsequent loss of capacity of certain dams, coupled with the difficulty in of migration posed by dams has led to the KNP blowing up some of the dams in the park.

2.3 Invasive/alien plants

Among other things, the dams and weirs serve as traps for the invasive plants as well as reservoirs for the nutrients put in the system by activities described earlier. These invasive aquatic plants are washed down the river whenever there are floods. This makes it difficult for the KNP invasive control unit to eradicate these unwanted species.

2.4 Rainfall

The rivers and catchments involving the KNP are governed by its largely semi-arid climate. This produces some of the most variable and unpredictable rainfall. The rainfall in the park is not favourable and it is forecasted that drought situation will continue to impact the KNP and environs for some years to come. The rainfall figures in the park is summarised below.

Table 1: KNP rainfall summary

MONITORING STATION	RAINFALL TOTALS (mm)							
	LONG-TERM AVERAGE ANNUAL TOTAL	TOTALS FOR THIS MONTH			CUMULATIVE TOTAL BY END OF THIS MONTH (Since 1 July)			
		LONG-TERM AVERAGE FOR MONTH a	THIS MONTH b	% OF MONTHLY AVERAGE c	AVERAGE CUMULATIVE TOTAL d	CUMULATIVE TOTAL BY MONTH END e	% OF AVERAGE CUMULATIVE TOTAL f	
PAFURI GATE	#440	•	****	•	•	****	•	
PAFURI RANGER (18)	466.1	8.8	0.0	0.0	463.2	336.0	75.5	
PAFURI WENELA (69)	423.6	8.2	0.2	2.4	419.1	481.4	114.9	
NYALALAND TRAILS	#450	•	0.0	•	•	****	•	
PUNDA MARIA (72)	530.6	9.7	****	****	524.4	****	****	
VLAKTEPLAAS (18)	515.1	9.2	0.0	0.0	509.5	178.5	35.0	
SIRHENI	#460	•	****	•	•	****	•	
SHINGWEDZI (40)	504.0	11.1	5.5	49.6	499.1	243.7	48.8	
SHANGONI (43)	458.2	13.1	1.7	13.0	542.3	220.2	40.6	
WOODLANDS (19)	478.9	10.2	6.3	61.8	470.7	341.1	72.5	
MOOIPLAAS (28)	496.3	13.6	1.0	7.4	492.1	309.9	63.0	
MAHLANGENI (42)	462.7	12.3	2.7	22.0	459.3	368.3	80.2	
SHIMUWINI	#420	•	****	•	•	****	•	
LETABA (45)	456.7	9.8	0.0	0.0	453.0	267.5	59.1	
PHALABORWA (63)	500.3	10.4	1.8	17.3	493.2	225.0	45.6	
OLIFANTS RANGER (27)	496.5	12.5	****	****	494.1	****	****	
OLIFANTS TRAILS	#390	•	****	•	•	****	•	
HOUTBOSCHRAND (19)	438.9	6.2	0.0	0.0	435.5	358.3	82.3	
SATARA (54)	543.7	11.5	0.5	4.3	536.9	433.5	80.7	
NWANETSI (33)	541.4	12.8	0.0	0.0	535.1	408.2	76.3	
KINGFISHERSPRUIT (41)	571.8	10.0	1.3	13.0	565.1	355.2	62.9	
TALAMATI	#670	•	6.4	•	•	****	•	
TSHOKWANE (60)	562.3	11.3	****	****	554.3	****	****	
SKUKUZA (76)	550.4	13.5	6.5	48.2	542.5	753.9	139.0	
LOWER SABIE (33)	602.6	15.8	****	****	593.2	****	****	
PRETORIUSKOP (60)	737.2	19.0	****	****	728.1	****	****	
JOCK SAFARI LODGE	#630	•	****	•	•	****	•	
BYAMITI	#555	•	17.5	•	•	366.6	•	
STOLZNEK (20)	672.9	11.0	4.3	39.1	666.1	591.1	88.7	
CROCODILE BRIDGE (55)	620.0	14.7	****	****	612.1	****	****	
WOLHUTER TRAILS	#590	•	****	•	•	****	•	
BOESMAN TRAILS	#640	•	6.0	•	•	439.7	•	
BERG EN DAL	#660	•	5.8	•	•	503.2	•	
MALELANE (85)	639.3	17.5	6.2	35.4	632.0	394.9	62.5	
AVERAGES FOR KNP	**537.2**	**11.8**	**3.4**	**18.4**	**531.2**	**378.8**	**72.2**	

EXPLANATORY NOTES:

Station with less than 15 years' of data. Figure in brackets next to the station name is the number of years' data used to calculate averages. At least 15 years' of data required for a reliable average. Average annual total in these cases is therefore an estimate. Monitoring stations are arranged in geographic sequence, north to south.

'Annual' = Climatic year, 1 July to 30 June. Annual averages calculated up to and including 2001/02.

• = No long-term averages available

**** = Data outstanding or incomplete (Averages unreliable due to too few returns received for the month).

AVERAGE FOR MONTH (a): The total received for this specific month, averaged over a period of at least 15 years.

THIS MONTH'S TOTAL (b): The total rainfall received during the current month.

% OF MONTHLY AVERAGE (c): The current month's total as a percent of the long-term average monthly total (b/a X 100%).

AVERAGE CUMULATIVE TOTAL (d): Starting at the beginning of the climatic year (July), the sum of each month's average monthly total, up to the end of the current month. By the end of the climatic year (end June), this total thus equals the long-term average annual total.

CUMULATIVE TOTAL BY MONTH END (e): Starting at the beginning of the climatic year (July), the sum of the monthly totals of the current climatic year (1 July to 30 June) up to and including the current month.

% OF AVERAGE CUMULATIVE TOTAL: The current month's cumulative total as a percent of the long-term average cumulative total by the end of the current month (e/d X 100%).

Figures in red: Below average; Figures in blue: above average

2.5 The Reserve

The only environmental reserve determined for the KNP Rivers that is being implemented is that of the Sabie River. Although all the rivers have In-stream Flow Requirements (IFRs) determined by the Department of Water Affairs and Forestry (DWAF), none is being implemented. DWAF talks about the verification and validation of water use but the question is when is this going to be completed? What will have happened to the biodiversity in the Kruger National Park? According to the National Water Act (36 of 1998), the environment is ranked the number 2 water user, second to the domestic water users. Questions therefore arise as to whether we as a country are very concerned about the fate of the aquatic environment/biodiversity.

2.6 Activities Downstream

Mozambique is currently raising the height of the dam walls of the Massingir and the Corumana dams. The KNP had no idea what was going on (not informed). The raising of the height of the walls will have immense impacts on the biodiversity of the KNP.

3. IMPACTS

3.1 Silt

One of the major impacts is silt in the system. The heavy silting and extraction has led to the progressive decrease in the quantity of water. This has contributed to the cessation of flow in the river during some seasons of the year.

Presently, Olifants and Letaba Rivers virtually dry up at some stretches, have high silt levels and high levels of different forms of pollution. These occurrences have led to the disappearance of some biological species from our rivers. The constant and recurring fish kills is of a major concern to KNP.

3.2 Fish Kills

The inventory of fish kills in the Olifants River in the Kruger National Park section is as follows.

Jan 1983: Very high rainfall in the Olifants River catchment causes water with a silt content of 78 700 ppm to flow into Kruger. Thousands of fish died of at least the following 7 species:

Scientific name	**English/common name**
Oreochromis mossambicus	Mozambique tilapia
Labeo spp	
Tilapia rendalli swierstrae	Southern redbreasted tilapia
Barbus marequensis	Largescale yellow fish
Eutropius depressirostis	Catfish (botterbaber)
Anguilla spp	Eels
Hydrocynus vittatus	Tiger fish

Dec 1987: Lots of dead fish in Olifants River due to high silt loads.

Dec 1989: Silt loads of 11000 ppm causes fish kills in the Olifants River.

Feb 1999: At least 5 species of fish found dead in Olifants River due to high silt loads, including:

Scientific name	**English/common name**
Hypophthalmichthys molitrix	Silver carp (exotic)
Oreochromis mossambicus	Mozambique tilapia
Labeo molybdinus	Plumbeous labeo
Labeo ruddi	Silver labeo
Tilapia rendalli swierstrae	Southern redbreasted tilapia

March 2000: Gerrie Marais, a local farmer reported a huge amount of dead fish, mainly Tilapia and Catfish, in the Selati River below Fedmis.

15 August 2001: Fish were dying below the Loskop Dam. “White spot” was identified.

Jul 03: Mostly Labeo’s died below the Phalaborwa Barrage.

Jan 04: Thousands of fish belonging to at least 8 species died in the Olifants River below the Barrage including:

Scientific name	**English/common name**
Hypophthalmichthys molitrix	Silver carp (exotic)
Oreochromis mossambicus	Mozambique tilapia
Labeo molybdinus	Plumbeous labeo
Labeo rosae	Red nose labeo
Chiloglanis paratus	Sawfin suckermouth
Barbus marequensis	Largescale yellowfish
Synodnotis zambezensis	Brown squeaker
Schilbe intermedius	Silver catfish

3.3 Low flows

The non-availability of sufficient water to the wild life is causing some elephants to break the fence to reach water on adjoining lands.

The Hippos are very uncomfortable since the pools (their preferred habitats) are drying up.

Fish die due to heat, predation by birds and other predators, competition for space and food, etc.

3.4 Activities Downstream, e.g. raising of dam walls

The raising of the height of walls of the Massingir and Corumana dams in Mozambique is seen as a big threat to the KNP. The gorges in the Olifants and Sabie will be flooded as the backwaters of the dam will push far inside the KNP. Many of the habitats for the aquatic species will be lost which will eventually lead to the disappearance of such species from these areas.

These will affect our biodiversity conservation plans as well as tourism in the Kruger National Park.

4. RECOMMENDATIONS

4.1 Institutional

The water resources of South Africa must be managed to ensure that the resources are sustainable for both current and future use. In doing so, we must protect the ecosystems (including their biodiversity) that depend on these water resources. Water is used for a variety of purposes including domestic water supply, irrigation, industrial use, mining, tourism and sustaining ecosystems. Water resources management must balance the needs of all water users. Primary production and industry support vibrant and productive communities that contribute significantly to national, State and regional economies. Healthy, sustainable and well-managed water resources are essential to the future viability and reliability of these communities and industries.

The Government has a responsibility to ensure that water is managed to achieve social and economic benefits in a manner that is environmentally sustainable. The Department of Water Affairs and Forestry (DWAF) have implemented or are in the process of implementing plans to reduce the impact on the ecosystem. Properly researched, transparent and tested management plans should be implemented by all stakeholders that have impacts on the rivers involving the KNP.

4.2 Legislation

Implementation/Application of relevant legislation, including;
Chapter 18 of Agenda 21
White Paper on National Water Policy
Conservation Act.
Biodiversity Act
National Water Act
National Water Resource Strategy

South Africa has a strong legislative framework through the National Water Act (36 of 1998) for providing water resources management measures. Our water resources would be better if these are adhered to. They include:

- Prescription of a water resource;
- Restrictions on water use;
- Development and implementation of catchment water management plans
- Development and implementation of water allocation plans for all prescribed water resources in the State;
- Extensive community consultation during the preparation of all water plans;
- Review of the condition of the water resources;
- Compilation, maintenance and updating of information concerning the State's natural resources.
- Sharing of information on the natural resource.

4.3 The Reserve

Reserve determination for all the rivers involving the KNP should be undertaken as a matter of urgency. Thereafter, a proper monitoring system should be put in place by all stakeholders concerned. A much more concerted action and proper law enforcement should then be embarked on to help solve the problem in the long run. In the mean time, operating rules being developed by DWAF in conjunction with stakeholders should be used to ensure equitable and judicious use of the water resources.

4.4 Catchment Forums

The River Forums that have been established throughout the catchments. Members include municipalities, farmers, the industries, mines, communities, government departments and the Kruger National Park is also creating awareness on the plight of the rivers in the KNP. Many more should be established. We need to work on "How water resource users & stakeholders will be able to influence decision-making and contribute to resource management (use patterns)", e.g.

- Through integrated management – involving everyone who has a stake or interest in the water resource. There are a number of institutions or role-players each of which has a different purpose and may want to satisfy itself first, i.e. water needs.
- Managing conflicts between stakeholders with different interests
- Creating buy-ins with/for the problem/vision at hand
- Educate the people about the problem at hand; let them understand issues at stake; empowerment – everybody should be considered as an important part of the group; understand each others problems.
- Work-out solutions together in relation to legislation and other guidelines – probable/alternatives to be dealt with. Resolution then becomes a voice of the people and authorities will have no option but heed.

4.5 Environmental Inspectors

Environmental Inspectors to supplement the efforts of the government departments is the way to go. Such inspectors with the technical and operational expertise can contribute towards the sound management of our water resources.

4.6 Inter Catchment Transfers

The transfers out of a catchment: In making its determination whether transfer may be permitted, the department shall:

- Protect present, and consider projected stream uses of the losing river basin generally and of the losing river specifically including, but not limited to, present agricultural, municipal, industrial and in-stream uses, and assimilative needs.
- Protect water quality of the losing river basin.
- Consider reasonably foreseeable future water needs of the losing river basin.
- Consider the reasonably foreseeable future water needs of the applicant for the water to be transferred, including methods of water use, conservation, and efficiency of use.
- Consider beneficial impact on the catchment and its local subcatchments of any proposed transfer, and the capability of the applicant to implement effectively its responsibilities under the requested permit.
- Consider the nature of the permittee's use of the water, to determine whether the use is reasonable and beneficial.
- Consider whether the proposed project shall promote and increase the storage and conservation of water.
- Consider the feasibility of alternative sources of supply and their comparative costs.
- Consider availability of water in the losing river basin to respond to emergencies, including drought.
- Consider whether the project shall have any beneficial or detrimental impact on fish and wildlife habitat, aesthetics, or recreation.
- Consider such other facts and circumstances as are reasonably necessary to carry out the purposes of the NWA.

4.7 Catchment Management Agencies

CMA's should monitor, control and or implement;

- Development along the rivers
- Research & Policy Development
- Information & Education of public
- Alien species control
- Wetlands dev't & protection
- Bank Erosion
- Resource protection
- Flow monitoring

- Water Quality Monitoring
  - Physical
  - Chemical
  - Microbiological
  - Biological
- Awareness - To promote and ensure a high level of awareness amongst and support from managers (internal and external), water users, action groups, politicians and the public.
- Co-operative governance
- Information management
- Delegated authority driving partnerships
- Communication at all levels
- Alignment of initiatives
- ecological integrity vs economic & social development
- Conservation targets vs river classification

For each prescribed resource, a water allocation plan should be prepared in close consultation with the stakeholders. Water allocation plans will provide information on water that is available for use as well as for the environment, and policies on the allocation and transfer of water. Where immediate controls are required to manage water resources that are under pressure, a notice of restriction or prohibition may be applied. This temporary control 'holds' water use at current levels while the capacity of the resource, its ability to provide for future growth and the need to prescribe the resource are assessed.

According to a UN report on water, ‘solutions are within reach, but because of political “inertia”, the future for many parts of the world looks bleak.’ Globally, the challenge lies in raising the political will to implement water-related commitments. Water professionals need a better understanding of the broader social, economic, and political context, while politicians need to be better informed about water resource issues.

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National Water Act (36 of 1998)

In stream Flow Requirements for the KNP Rivers